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12. PERSONAL AUTHOR(S)
Thomas H. Kinder, Donald A. Burns, and Michael R. Wilcox*

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The data from this June 1986 hydrographic cruise form part of a broad study of the dynamics and kinematics of the Strait of Gibraltar. The station plan was chosen to resolve the hydrographic structure within the strait and approaches, as well as the variability induced by the semidiurnal and diurnal tides. To resolve small differences in water mass properties within the Mediterranean Water, all stations extended within 10 m of the bottom. Vertical profiles and temperature-salinity correlations are given for each of the 319 casts obtained during the period 17–29 June 1986. The details of the salinity calibration are discussed.

The profiles show many small-scale (several meters) features, including density inversions, for stations taken near the sill. The time series stations show the large-amplitude internal tide with both semidiurnal and diurnal periodicity.

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NORDA Technical Note 378
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Hydrographic Measurements in the Strait of Gibraltar, June 1986, by

Thomas H. Kinder and others.
Donald A. Burns
Oceanography Division
Ocean Science Directorate

Michael R. Wilcox
Planning Systems, Inc.
Slidell, Louisiana

Abstract

The data from this June 1986 hydrographic cruise form part of a broad study of the dynamics and kinematics of the Strait of Gibraltar. The station plan was chosen to resolve the hydrographic structure within the strait and approaches, as well as the variability induced by the semidiurnal and diurnal tides. To resolve small differences in water mass properties within the Mediterranean Water, all stations extended within 10 m of the bottom. Vertical profiles and temperature-salinity correlations are given for each of the 319 casts obtained during the period 17–29 June 1986. The details of the salinity calibration are discussed.

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Acknowledgments

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H. W. Amos (electronics technician) and Bruce H. Nelson (ship manager, both of the U.S. Naval Oceanographic Office, NSTL, Mississippi) also provided invaluable assistance. Code 422CS of the Office of Naval Research, Dr. Dennis Conlon and Dr. Alan Brandt, Program Managers, funded this work under program element 61153N.

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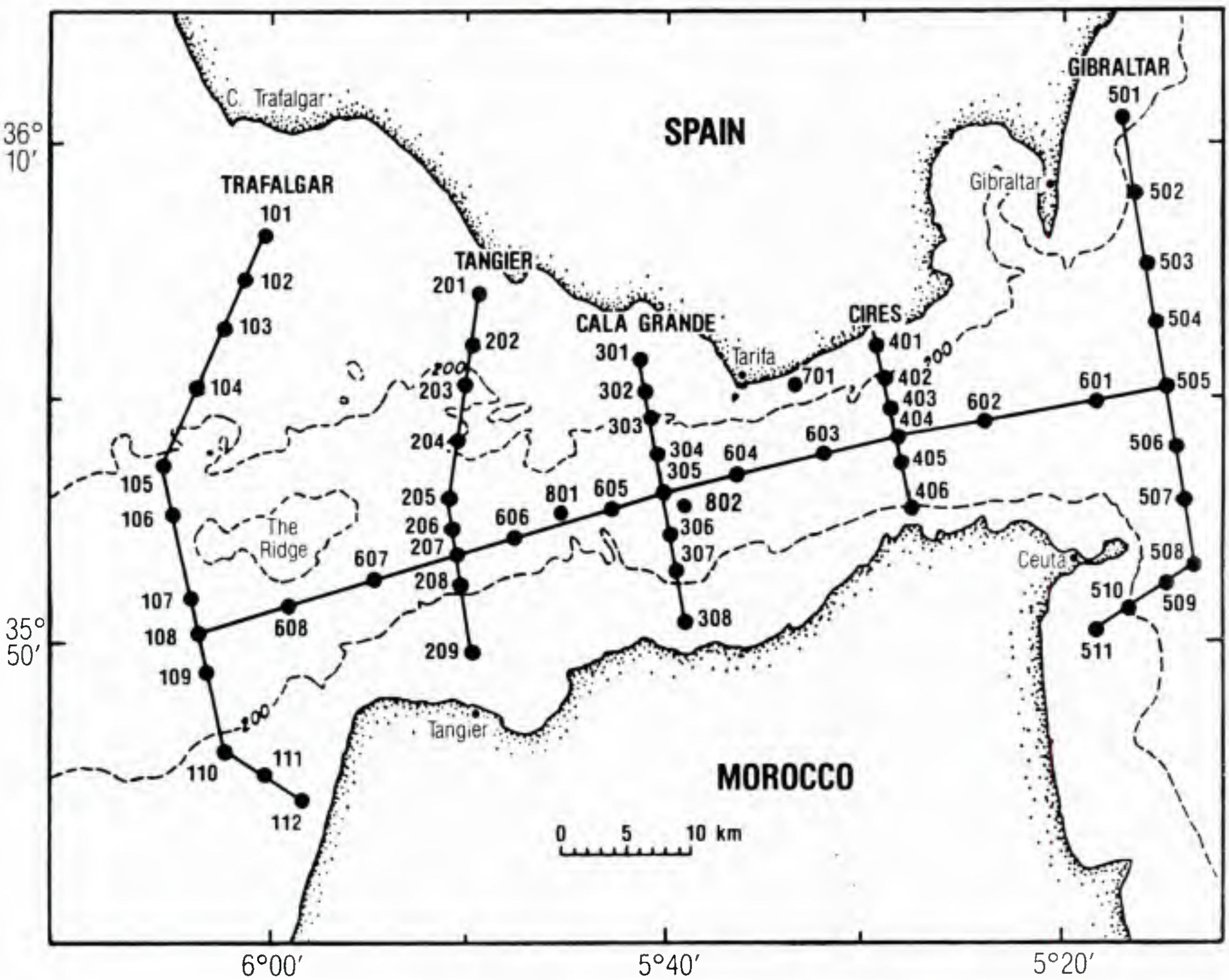

Figure 1. Station grid used in November 1985.

Hydrographic measurements in the Strait of Gibraltar, June 1986

1. Introduction

During 17–29 June 1986 we took 319 CTD (conductivity-temperature-depth profiler) casts in the Strait of Gibraltar and its approaches to study the hydrographic structure. This cruise, a part of a broad study of the dynamics and kinematics of the strait, was entitled the "Gibraltar Experiment" (Bryden and Kinder, 1986).

2. Cruise plan

The original cruise objectives were designed to complement the November 1985 cruise (Kinder et al., 1986). A major part of this earlier cruise consisted of cross-strait sections that were timed to resolve the diurnal tidal period. We felt that the most important complementary data would be exact repetitions of these cross-strait sections, but with sampling sufficient to resolve the semidiurnal tidal component. We therefore planned to spend about 90% of the cruise occupying these sections. These plans had to be altered, however, when we were denied permission to work in Spanish territorial waters early on 20 June (the issue that stimulated the denial was apparently unrelated to the Gibraltar Experiment). We then recast the cruise to address other objectives. Fortunately, the major sill and the strong Atlantic inflow are on the African side of the strait, and the ship had permission to work in Moroccan waters. The cruise objectives were to

- gather time series data on either side of the sill, at both spring and neap tides, to determine the variability of both the Atlantic and Mediterranean Waters over semidiurnal and diurnal periods;
- estimate the variability in the Mediterranean Water west of Cape Spartel (after the outflowing water has undergone substantial mixing);
- obtain an along-strait section for comparison to the November 1985 data and to the hydrographic data obtained by the Scripps Institution of Oceanography (Bray, 1986);
- obtain data during the French B-17 Synthetic Aperture Radar (SAR) flights to identify the internal structure corresponding to surface features detected by the SAR (Wadsworth, 1986).

Figure 1 shows the station grid that was used in November 1985. During the June cruise only, a subset of these stations was occupied (Table 1). The longest time series was done at station 606 west of the sill and at station 802 east of the sill. Station 606 was located close to the sill, but far enough away from the moorings located there to ensure a reasonable margin of safety. Station 802 was located to correspond to a request by Claude Richez (Laboratoire d'Oceanographie, Dynamique et de Climatologie, Universite de Paris) for complementary data during her aircraft flights with a SAR.

The first data were taken at station 108 (Fig. 1 and Table 1) with 26 casts over a 13-hour period. We then began the cross-strait grid, which was terminated at 0700 on 20 June (all times are GMT) when the denial of diplomatic permission was received. The first long time series began west of the sill (station 606) at 1800 on 20 June and consisted of 40 casts over 25 hours during spring tide. This series was followed by a 25-hour and 38-cast occupation of station 802 (casts 113–150). The first aircraft flight occurred during this station from about 1000 to 2030 on 22 June. Station 800, located east of Gibraltar in the Alboran Sea, was done next as a calibration station (not shown in Fig. 1).

For the second aircraft flight, we intended a more complicated sampling strategy. Late on 23 and early on 24 June we planned to "tow-yo" west of the sill during the outgoing (westward) tidal flow. During this tidal phase a large internal lee wave forms west of the sill, and by slowly drifting westward we planned to measure the wave with close horizontal spacing. Following the turning of the tide, early on 24 June, we planned to change our position to the vicinity of station 802. At the turning of the tidal current, the lee wave propagates eastward and evolves into a packet of smaller waves. The horizontal and the temporal resolution were to be increased by recording on both up- and downcasts (for other stations we recorded on downcasts only) and by limiting the depth of the casts (to the 38.2 isohaline west of the sill, and the 38.4 isohaline east of the sill). We thus intended to encompass the entire pycnocline, and also to enhance the horizontal and temporal resolution of the lee waves and their propagating counterparts. The lee-wave

profiling station, designated 901, began in the early evening of 23 June. We had limited success in maneuvering the ship to drift westward over the deep channel and completed 12 casts (12 down- and 12 up-casts) by about 0100 on 24 June. At this time the watch section observed a large flotation sphere that was adrift near the ship and that belonged to the Woods Hole Oceanographic Institution and the Oregon State University. CTD work was suspended to track the sphere until first light, when the sphere was recovered. The ship then steamed eastward and overtook the wave packet near 5°34′W and began a series of 9 yo-yo casts that were designated station 902. The B-17 aircraft made measurements during the period 0513–1125, which included station 902.

The remainder of the cruise was used for an along-strait section on 24 June, and two time series stations at 606 and 802 during neap tide (spring tide occurred on 22 June, neap tide on 30 June). Station 802 covered 47 hours and 64 casts on 25–27 June. This time-series station had a 5-hour hiatus on 26 June when the Woods Hole/Oregon State mooring C-3 (located on the southern sill) was recovered. This unscheduled recovery was triggered by the discovery of the flotation sphere on 24 June, which had been the shallowest component of subsurface mooring C-3. Station 606 covered 48 hours and 72 casts on 27–29 June.

We wanted to accurately measure the small differences in water mass properties within the Mediterranean Water. The earlier data of the 1960s did not do this (e.g., Lacombe and Richez, 1982; 1984), and more recent work (e.g., Bryden and Stommel, 1982; Gascard and Richez, 1985) had very scanty coverage. Detailed hydrographic measurements, both alone and when combined with other measurements, can be used to answer important scientific questions about the strait (Kinder and Parrilla, 1987). We were therefore interested in accurate salinity measurements (see Section 3) that extended close to the bottom. Except for the lee wave and wave packet stations (901 and 902), all casts were within 10 m of the bottom.

3. Data collection and processing

Data were acquired with a Neil Brown Mk III CTD that was lowered at 60 m/min. Data were recorded on digital and audio-magnetic tapes. Water samples were obtained by Rosette sampler to calibrate the CTD measurements. Sufficient in situ data were obtained to adjust the CTD values (Table 2). Water sample salinities were determined using a Guildline salinometer. Although samples were collected at shallow depths and west of the sill, the deep samples obtained east of the sill in the Mediterranean Water are most useful for calibration because of the greater stability of salinity values there. The CTD was 0.010 lower in salinity than the water samples, and this correction was applied to all data. Note that the calibration station (800, cast 151; see profile and temperature-salinity plot) appeared to have instrumental problems over part of the cast. There was no evidence of this during the upcast, however, when the water samples are collected and CTD values are recorded for comparison. After applying the correction, we claim an accuracy of 0.005°C, 0.005 salinity, and 5 dbar.

Radar and visual bearings were used for navigation, and for most stations the position at the beginning of the station (recorded in Table 1) was accurate to 200 m. Strong currents, sometimes in excess of 2 m/sec, caused considerable ship drift during some of the deep stations (downcast duration in excess of 15 minutes). Excellent radar ranges were available throughout the strait, but near the Moroccan coast on the Trafalgar section this was not the case, and these shelf stations are probably within 500 m.

During processing, the raw data were edited to remove spikes. In a few cases, obviously bad data extended over many samples and were removed by manual editing (Table 3). Several stations, such as 800 (cast 151) contained clearly erroneous data over an extended pressure range. No editing was attempted in such cases. Following editing, the data were pressure sorted and filtered to produce 1-dbar averages (Hallock, 1982). Salinities were calculated using the 1978 practical salinity scale (Lewis and Perkin, 1981) and density (as σ_θ) using Fofonoff and Millard (1983). In the Mediterranean Water, our values will differ from earlier papers using older algorithms. The deep-water salinities are about 0.006 lower (Lewis and Perkin, 1981) and the densities about 0.02 kg/m^3 lower (Parrilla, 1984) than the earlier definitions.

There were multiple failures in the data acquisition system, including both the digital and analog tape recorders. Some of the data were recovered from analog tapes that originated from a noisy recorder. This resulted in the large number of small data segments (listed in Table 3) that were replaced by linear interpolation. Most of the segments were less than 2 dbar in extent, and no casts had more than a few decibars replaced. On one cast (802213), the digital tape deck did not record properly on the downcast, so a recording of the upcast was made and substituted for the missing downcast.

4. Discussion

We show three plots for each cast, which are numbered as follows: SSSCCC. For example, 105043 is cast number 43 (a consecutive number assigned to each group of CTD data), which was done at station number 105 (a geographical position; see Fig. 1). Upcasts have the same format with the suffix "U" added. For example, 901163U is the upcast following downcast number 163, which was done at station 901 (lee wave station). The profile plot has potential

temperature, salinity, and potential density (as σ_θ) versus pressure. The salinity and density lines are difficult to distinguish in many of these plots, but salinity lies to the right of density in the Mediterranean Water (maximum values are about 38.4 and 29.1, respectively). Also shown are two temperature-salinity correlation plots, one for the entire range of values and one for the Mediterranean Water only.

As in the November 1985 data set (Kinder et al., 1986), many small-scale features extended over meters or tens of meters, including density inversions. These features are especially prevalent at station 606, west of the sill. Since most of these features lie within the gross temperature-salinity correlation for their respective station, they are out of sequence in pressure but are not anomalous in temperature-salinity. Such features seem physically probable, as the energetic mechanical stirring within the strait would be expected to force such inversions with temperature-salinity correlations similar to adjacent water. There are also similar features that depart from the temperature-salinity correlation, and we evaluate these as instrument error (e.g., cast 800151).

5. CTD Profiles

The CTD profiles are published separately in NORDA Technical Note 378-1 (Appendix) and can be requested from the authors. Please contact D. A. Burns, NORDA Code 331, NSTL, MS 39529-5004.

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Table 1. Station list for *Lynch* Cruise 707–86

Cast	Station	Year Day	Date	Time (GMT)	Depth (m)	Latitude (N)	Longitude (W)	Remarks
				Trafalgar Time Series				
001	108	168	17 Jun	1425	448	35-50.6	6-04.0	
002	108	168	17 Jun	1505	365	35-50.2	6-03.7	
003	108	168	17 Jun	1534	384	35-50.6	6-04.2	
004	108	168	17 Jun	1605	416	35-50.5	6-04.0	
005	108	168	17 Jun	1634	433	35-50.5	6-03.8	
006	108	168	17 Jun	1702	434	35-50.4	6-03.7	
007	108	168	17 Jun	1733	420	35-50.5	6-03.9	
008	108	168	17 Jun	1820	395	35-50.3	6-04.7	
009	108	168	17 Jun	1859	403	35-50.6	6-04.3	
010	108	168	17 Jun	1930	420	35-50.5	6-04.0	
011	108	168	17 Jun	2000	419	35-50.4	6-04.5	
012	108	168	17 Jun	2031	408	35-50.6	6-04.1	
013	108	168	17 Jun	2059	418	35-50.4	6-04.3	
014	108	168	17 Jun	2129	415	35-50.6	6-04.2	
015	108	168	17 Jun	2201	423	35-50.5	6-04.2	
016	108	168	17 Jun	2234	420	35-50.6	6-04.1	
017	108	168	17 Jun	2300	420	35-50.5	6-04.0	
018	108	168	17 Jun	2330	424	35-50.5	6-03.9	
019	108	169	18 Jun	0000	437	35-50.4	6-03.8	
020	108	169	18 Jun	0038	437	35-50.4	6-03.9	
021	108	169	18 Jun	0101	441	35-50.5	6-03.8	
022	108	169	18 Jun	0130	421	35-50.4	6-03.9	
023	108	169	18 Jun	0159	436	35-50.5	6-04.1	
024	108	169	18 Jun	0230	423	35-50.5	6-04.2	
025	108	169	18 Jun	0300	438	35-50.6	6-03.9	
026	108	169	18 Jun	0329	430	35-50.6	6-03.9	
				Trafalgar Section				
027	101	169	18 Jun	0558	60	36-07.1	5-59.0	
028	102	169	18 Jun	0630	90	36-04.4	6-01.0	
029	103	169	18 Jun	0702	120	36-01.8	6-02.8	
030	104	169	18 Jun	0729	173	35-59.5	6-04.2	
031	105	169	18 Jun	0814	247	35-57.2	6-06.0	
032	106	169	18 Jun	0859	325	35-54.5	6-05.2	
033	107	169	18 Jun	1120	323	35-51.6	6-03.9	
034	108	169	18 Jun	1208	390	35-50.5	6-04.0	
035	109	169	18 Jun	1256	387	35-49.1	6-03.6	
036	110	169	18 Jun	1407	85	35-45.5	6-02.7	
037	111	169	18 Jun	1432	70	35-44.6	6-01.2	
038	112	169	18 Jun	1456	38	35-43.3	5-59.3	
039	101	170	19 Jun	0005	58	36-07.0	5-59.2	
040	102	170	19 Jun	0040	77	36-04.5	6-01.0	
041	103	170	19 Jun	0116	111	36-02.1	6-02.6	
042	104	170	19 Jun	0153	162	35-59.6	6-04.2	
043	105	170	19 Jun	0250	226	35-57.0	6-06.2	
044	106	170	19 Jun	0334	332	35-54.5	6-05.4	
045	107	170	19 Jun	0420	337	35-51.6	6-04.3	
046	108	170	19 Jun	0450	423	35-57.0	6-06.2	
047	109	170	19 Jun	0524	342	35-49.1	6-03.6	
048	110	170	19 Jun	0609	69	35-45.4	6-02.7	
049	111	170	19 Jun	0635	57	35-44.2	6-02.7	
050	112	170	19 Jun	0658	40	35-43.0	5-59.2	
				Tangier Section				
051	201	170	19 Jun	1358	57	36-04.5	5-50.0	
052	202	170	19 Jun	1427	168	36-02.2	5-50.5	
053	203	170	19 Jun	1501	198	35-59.9	5-50.9	
054	204	170	19 Jun	1549	314	35-57.8	5-51.3	
055	205	170	19 Jun	1643	317	35-55.5	5-52.1	
056	206	170	19 Jun	1713	479	35-53.8	5-51.6	
057	207	170	19 Jun	1753	456	35-52.3	5-51.8	
058	208	170	19 Jun	1840	289	35-51.8	5-51.3	

Table 1. (Continued)

Cast	Station	Year Day	Date	Time (GMT)	Depth (m)	Latitude (N)	Longitude (W)	Remarks
				Tangier Section (Continued)				
059	209	170	19 Jun	1929	92	35-50.1	5-51.0	
060	201	170	19 Jun	2123	55	36-04.4	5-50.0	
061	202	170	19 Jun	2154	128	36-02.2	5-50.4	
062	203	170	19 Jun	2223	207	36-00.5	5-51.0	
063	204	170	19 Jun	2306	426	35-57.7	5-51.2	
064	205	171	20 Jun	0010	277	35-55.4	5-52.1	
065	206	171	20 Jun	0054	478	35-54.0	5-51.8	
066	207	171	20 Jun	0146	601	35-52.8	5-51.6	
067	208	171	20 Jun	0237	310	35-52.0	5-51.5	
068	209	171	20 Jun	0312	97	35-50.0	5-51.0	
				Cala Grande Section				
069	301	171	20 Jun	0445	109	36-00.8	5-39.5	
070	302	171	20 Jun	0503	196	36-00.0	5-39.8	
071	303	171	20 Jun	0528	367	35-58.6	5-39.6	
072	304	171	20 Jun	0620	480	35-57.7	5-38.8	
				West of Sill Time Series				
073	606	171	20 Jun	1804	588	35-53.8	5-47.0	
074	606	171	20 Jun	1838	614	35-54.0	5-47.0	
075	606	171	20 Jun	1930	500	35-53.7	5-47.2	
076	606	171	20 Jun	2002	424	35-53.6	5-47.3	
077	606	171	20 Jun	2027	390	35-53.6	5-47.3	
078	606	171	20 Jun	2124	429	35-53.8	5-47.0	
079	606	171	20 Jun	2210	406	35-53.7	5-47.5	
080	606	171	20 Jun	2250	462	35-53.7	5-47.2	
081	606	171	20 Jun	2332	467	35-53.9	5-47.3	
082	606	172	21 Jun	0018	445	35-53.6	5-47.2	
083	606	172	21 Jun	0101	513	35-53.8	5-47.3	
084	606	172	21 Jun	0130	469	35-53.8	5-47.3	
085	606	172	21 Jun	0211	498	35-53.7	5-47.3	
086	606	172	21 Jun	0348	533	35-53.8	5-47.4	
087	606	172	21 Jun	0421	477	35-53.8	5-47.4	
088	606	172	21 Jun	0508	476	35-53.9	5-47.3	
089	606	172	21 Jun	0538	474	35-54.0	5-47.3	
090	606	172	21 Jun	0617	495	35-53.9	5-47.5	
091	606	172	21 Jun	0638	446	35-53.8	5-47.8	
092	606	172	21 Jun	0658	436	35-53.8	5-47.8	
093	606	172	21 Jun	0732	536	35-53.8	5-47.2	
094	606	172	21 Jun	0802	430	35-53.9	5-47.4	
095	606	172	21 Jun	0837	435	35-53.7	5-47.2	
096	606	172	21 Jun	0858	377	35-54.2	5-48.0	
097	606	172	21 Jun	0934	439	35-53.8	5-47.3	
098	606	172	21 Jun	1018	437	35-53.8	5-47.2	
099	606	172	21 Jun	1053	417	35-53.7	5-47.1	
100	606	172	21 Jun	1126	480	35-53.9	5-47.3	Cast to 356 dbar only
101	606	172	21 Jun	1206	483	35-54.0	5-47.4	
102	606	172	21 Jun	1250	505	35-53.8	5-47.2	
103	606	172	21 Jun	1329	505	35-53.9	5-47.3	
104	606	172	21 Jun	1400	464	35-53.8	5-47.4	Estimated position
105	606	172	21 Jun	1432	601	35-53.8	5-47.4	
106	606	172	21 Jun	1504	480	35-53.8	5-46.8	
107	606	172	21 Jun	1542	616	35-53.8	5-47.2	
108	606	172	21 Jun	1629	441	35-53.8	5-47.7	
109	606	172	21 Jun	1700	450	35-53.8	5-47.7	
110	606	172	21 Jun	1731	388	35-53.8	5-47.7	
111	606	172	21 Jun	1802	554	35-53.3	5-47.2	
112	606	172	21 Jun	1841	504	35-53.8	5-46.5	

Table 1. (Continued)

Cast	Station	Year Day	Date	Time (GMT)	Depth (m)	Latitude (N)	Longitude (W)	Remarks
				East of Sill Time Series Station				
113	802	173	22 Jun	0218	597	35-55.1	5-37.8	
114	802	173	22 Jun	0246	587	35-55.1	5-37.9	
115	802	173	22 Jun	0324	619	35-55.1	5-37.9	
116	802	173	22 Jun	0354	702	35-54.8	5-38.2	
117	802	173	22 Jun	0435	598	35-54.8	5-38.2	
118	802	173	22 Jun	0504	602	35-54.8	5-38.2	
119	802	173	22 Jun	0544	640	35-55.2	5-38.7	
120	802	173	22 Jun	0627	621	35-55.0	5-39.0	
121	802	173	22 Jun	0652	683	35-55.3	5-38.0	
122	802	173	22 Jun	0736	607	35-54.9	5-38.8	
123	802	173	22 Jun	0817	613	35-54.9	5-38.8	
124	802	173	22 Jun	0842	581	35-55.0	5-38.8	
125	802	173	22 Jun	0917	639	35-55.2	5-38.9	
126	802	173	22 Jun	1018	610	35-55.2	5-38.8	
127	802	173	22 Jun	1102	614	35-55.2	5-38.8	
128	802	173	22 Jun	1138	631	35-54.8	5-38.7	
129	802	173	22 Jun	1218	598	35-55.2	5-38.8	
130	802	173	22 Jun	1254	605	35-55.3	5-38.9	
131	802	173	22 Jun	1338	626	35-55.2	5-38.8	
132	802	173	22 Jun	1410	603	35-55.2	5-38.8	
133	802	173	22 Jun	1439	622	35-54.9	5-39.0	
134	802	173	22 Jun	1531	608	35-54.9	5-39.0	
135	802	173	22 Jun	1625	672	35-55.4	5-38.7	
136	802	173	22 Jun	1731	755	35-55.2	5-38.8	
137	802	173	22 Jun	1834	729	35-55.0	5-38.9	
138	802	173	22 Jun	1927	680	35-55.2	5-38.7	
139	802	173	22 Jun	2009	652	35-54.8	5-38.9	
140	802	173	22 Jun	2102	587	35-55.0	5-39.0	
141	802	173	22 Jun	2139	602	35-55.3	5-38.8	
142	802	173	22 Jun	2221	586	35-55.2	5-38.8	
143	802	173	22 Jun	2307	560	35-55.0	5-38.9	
144	802	173	22 Jun	2351	584	35-55.2	5-38.8	
145	802	174	23 Jun	0027	582	35-55.0	5-38.9	
146	802	174	23 Jun	0105	588	35-55.2	5-38.8	
147	802	174	23 Jun	0147	590	35-55.3	5-39.0	
148	802	174	23 Jun	0214	589	35-55.3	5-39.0	
149	802	174	23 Jun	0244	456	35-55.4	5-39.5	
150	802	174	23 Jun	0320	583	35-55.1	5-38.9	
				Calibration Station				
151	800	174	23 Jun	1150	873	36-04.4	5-01.7	
				Lee Wave Profiling				
152	901	174	23 Jun	1925	430	35-53.6	5-46.8	To 347 dbar only
153	901	174	23 Jun	1944	410	35-53.9	5-46.2	To 304 dbar only
154	901	174	23 Jun	2033	385	35-54.1	5-49.2	To 296 dbar only
155	901	174	23 Jun	2101	405	35-54.0	5-49.1	To 318 dbar only
156	901	174	23 Jun	2117	430	35-54.0	5-48.7	To 328 dbar only
157	901	174	23 Jun	2132	395	35-53.9	5-48.8	To 341 dbar only
158	901	174	23 Jun	2231	278	35-53.4	5-45.3	
159	901	174	23 Jun	2250	152	35-53.2	5-45.2	
160	901	174	23 Jun	2306	85	35-52.8	5-45.2	
161	901	174	23 Jun	2342	341	35-53.4	5-45.4	To 294 dbar only
162	901	175	24 Jun	0000	252	35-53.3	5-46.2	
163	901	175	24 Jun	0017	146	35-53.0	5-46.2	
				Wave Packet Profiling				
164	902	175	24 Jun	0620	655	35-55.8	5-34.8	To 269 dbar only
165	902	175	24 Jun	0631	650	35-56.0	5-34.6	To 272 dbar only
166	902	175	24 Jun	0645	700	35-56.5	5-33.7	To 292 dbar only
167	902	175	24 Jun	0702	695	35-56.8	5-32.6	To 248 dbar only

Table 1. (Continued)

Cast	Station	Year Day	Date	Time (GMT)	Depth (m)	Latitude (N)	Longitude (W)	Remarks
				Wave Packet Profiling (Continued)				
168	902	175	24 Jun	0717	730	35-56.8	5-32.5	To 335 dbar only
169	902	175	24 Jun	0732	980	35-56.8	5-31.9	To 266 dbar only
170	902	175	24 Jun	0746	700	35-56.8	5-32.0	To 235 dbar only
171	902	175	24 Jun	0802	700	35-56.8	5-32.0	To 299 dbar only
172	902	175	24 Jun	0821	750	35-56.8	5-31.8	To 294 dbar only
				Alongstrait Section				
173	108	175	24 Jun	1156	415	35-50.4	6-03.8	
174	608	175	24 Jun	1243	365	35-51.3	5-59.8	
175	607	175	24 Jun	1333	403	35-52.3	5-54.7	
176	207	175	24 Jun	1415	449	35-52.8	5-52.3	
177	606	175	24 Jun	1525	443	35-53.3	5-47.0	
178	605	175	24 Jun	1609	446	35-54.8	5-41.4	
179	305	175	24 Jun	1648	586	35-54.8	5-39.3	
180	604	175	24 Jun	1738	472	35-55.2	5-35.2	
181	603	175	24 Jun	1837	611	35-57.7	5-31.0	
182	404	175	24 Jun	1932	956	35-58.2	5-28.0	
183	602	175	24 Jun	2032	880	35-59.0	5-23.5	
184	601	175	24 Jun	2137	889	36-00.1	5-19.2	
				East of Sill Time Series Station				
185	802	176	25 Jun	0205	576	35-55.1	5-38.7	
186	802	176	25 Jun	0241	532	35-55.2	5-38.7	
187	802	176	25 Jun	0331	568	35-55.1	5-38.7	
188	802	176	25 Jun	0359	611	35-55.3	5-39.2	
189	802	176	25 Jun	0439	583	35-55.3	5-38.8	
190	802	176	25 Jun	0520	576	35-55.3	5-38.9	
191	802	176	25 Jun	0605	629	35-55.1	5-38.8	
192	802	176	25 Jun	0640	669	35-55.0	5-38.8	
193	802	176	25 Jun	0736	636	35-55.0	5-38.9	
194	802	176	25 Jun	0800	640	35-55.0	5-38.9	
195	802	176	25 Jun	0846	600	35-55.0	5-39.0	
196	802	176	25 Jun	0920	635	35-55.0	5-38.9	
197	802	176	25 Jun	1000	593	35-54.9	5-38.8	
198	802	176	25 Jun	1040	626	35-55.1	5-38.8	
199	802	176	25 Jun	1120	580	35-55.0	5-38.8	
200	802	176	25 Jun	1200	605	35-55.1	5-38.8	
201	802	176	25 Jun	1240	578	35-55.1	5-38.8	
202	802	176	25 Jun	1320	584	35-55.2	5-38.9	
203	802	176	25 Jun	1402	580	35-55.2	5-38.7	
204	802	176	25 Jun	1440	533	35-55.2	5-38.9	
205	802	176	25 Jun	1524	531	35-55.2	5-38.7	
206	802	176	25 Jun	1600	595	35-55.3	5-38.9	
207	802	176	25 Jun	1640	546	35-55.2	5-38.9	
208	802	176	25 Jun	1720	543	35-55.4	5-39.0	
209	802	176	25 Jun	1801	716	35-54.8	5-38.8	
210	802	176	25 Jun	1855	622	35-54.9	5-39.0	
211	802	176	25 Jun	1945	699	35-55.0	5-38.8	
212	802	176	25 Jun	2030	705	35-54.8	5-38.9	
213	802	176	25 Jun	2116	674	35-55.0	5-39.0	
214	802	176	25 Jun	2209	719	35-55.0	5-38.6	
215	802	176	25 Jun	2300	627	35-55.2	5-38.8	
216	802	176	25 Jun	2337	612	35-55.1	5-38.8	
217	802	177	26 Jun	0004	609	35-55.0	5-38.8	
218	802	177	26 Jun	0040	613	35-55.1	5-38.6	
219	802	177	26 Jun	0120	624	35-55.2	5-38.6	
220	802	177	26 Jun	0200	577	35-55.2	5-38.8	
221	802	177	26 Jun	0240	567	35-55.2	5-38.8	
222	802	177	26 Jun	0320	555	35-55.3	5-38.9	
(NOTE: Unscheduled recovery of Woods Hole and Oregon State current meter mooring C-3)								
223	802	177	26 Jun	0831	598	35-55.1	5-38.9	
224	802	177	26 Jun	0910	595	35-54.5	5-38.4	

Table 1. (Continued)

Cast	Station	Year Day	Date	Time (GMT)	Depth (m)	Latitude (N)	Longitude (W)	Remarks
				East of Sill Time Series Station (Continued)				
225	802	177	26 Jun	0951	663	35-55.2	5-38.2	
226	802	177	26 Jun	1050	641	35-55.2	5-38.7	
227	802	177	26 Jun	1120	649	35-55.2	5-38.6	
228	802	177	26 Jun	1200	592	35-55.2	5-38.9	
229	802	177	26 Jun	1240	619	35-55.2	5-38.8	
230	802	177	26 Jun	1320	610	35-55.1	5-38.8	
231	802	177	26 Jun	1403	530	35-55.2	5-38.0	
232	802	177	26 Jun	1442	538	35-54.4	5-39.6	
233	802	177	26 Jun	1520	436	35-55.1	5-38.9	
234	802	177	26 Jun	1600	548	35-55.3	5-39.1	
235	802	177	26 Jun	1640	555	35-55.2	5-38.9	
236	802	177	26 Jun	1720	632	35-55.3	5-39.3	
237	802	177	26 Jun	1800	735	35-55.0	5-38.5	
238	802	177	26 Jun	1858	577	35-54.6	5-38.8	
239	802	177	26 Jun	1937	707	35-55.0	5-38.8	
240	802	177	26 Jun	2024	696	35-54.5	5-38.9	
241	802	177	26 Jun	2111	607	35-54.7	5-38.8	
242	802	177	26 Jun	2201	722	35-55.1	5-38.8	
243	802	177	26 Jun	2250	688	35-55.1	5-38.8	
244	802	177	26 Jun	2332	643	35-55.2	5-38.8	
245	802	178	27 Jun	0009	656	35-55.1	5-38.8	
246	802	178	27 Jun	0046	617	35-55.1	5-38.8	
247	802	178	27 Jun	0132	598	35-55.1	5-38.8	
				West of Sill Time Series Station				
248	606	178	27 Jun	1403	409	35-54.0	5-47.2	
249	606	178	27 Jun	1440	409	35-53.7	5-47.3	
250	606	178	27 Jun	1520	430	35-53.8	5-47.2	
251	606	178	27 Jun	1600	545	35-53.8	5-47.2	
252	606	178	27 Jun	1640	601	35-53.7	5-47.4	
253	606	178	27 Jun	1720	499	35-53.7	5-47.1	
254	606	178	27 Jun	1800	420	35-53.0	5-47.2	
255	606	178	27 Jun	1841	537	35-53.8	5-47.1	
256	606	178	27 Jun	1920	587	35-53.8	5-46.6	
257	606	178	27 Jun	1956	580	35-53.8	5-47.1	
258	606	178	27 Jun	2040	582	35-53.7	5-47.0	
259	606	178	27 Jun	2125	502	35-53.8	5-46.9	
260	606	178	27 Jun	2206	514	35-53.8	5-47.2	
261	606	178	27 Jun	2242	543	35-53.8	5-47.3	
262	606	178	27 Jun	2321	528	35-53.8	5-47.2	
263	606	179	28 Jun	0003	558	35-53.8	5-47.3	
264	606	179	28 Jun	0046	464	35-53.9	5-47.2	
265	606	179	28 Jun	0122	546	35-53.9	5-47.2	
266	606	179	28 Jun	0204	432	35-53.8	5-47.2	
267	606	179	28 Jun	0240	441	35-53.7	5-47.3	
268	606	179	28 Jun	0320	462	35-53.7	5-47.2	
269	606	179	28 Jun	0400	430	35-53.6	5-47.2	
270	606	179	28 Jun	0440	544	35-53.9	5-47.2	
271	606	179	28 Jun	0520	520	35-53.8	5-47.2	
272	606	179	28 Jun	0602	446	35-54.0	5-47.2	
273	606	179	28 Jun	0646	434	35-53.8	5-47.5	
274	606	179	28 Jun	0720	496	35-53.7	5-47.0	
275	606	179	28 Jun	0800	487	35-53.5	5-47.2	
276	606	179	28 Jun	0838	590	35-53.8	5-47.2	
277	606	179	28 Jun	0921	616	35-53.8	5-46.9	
278	606	179	28 Jun	1003	577	35-54.0	5-47.3	
279	606	179	28 Jun	1041	495	35-53.9	5-47.2	
280	606	179	28 Jun	1120	472	35-53.8	5-47.3	
281	606	179	28 Jun	1159	451	35-53.8	5-47.3	
282	606	179	28 Jun	1242	425	35-53.7	5-47.3	
283	606	179	28 Jun	1320	474	35-53.8	5-47.3	
284	606	179	28 Jun	1400	366	35-53.7	5-47.3	

Table 1. (Concluded)

Cast	Station	Year Day	Date	Time (GMT)	Depth (m)	Latitude (N)	Longitude (W)	Remarks
				West of Sill Time Series Station (Continued)				
285	606	179	28 Jun	1440	556	35-53.7	5-47.2	
286	606	179	28 Jun	1521	435	35-53.8	5-47.4	
287	606	179	28 Jun	1600	415	35-53.7	5-47.5	
288	606	179	28 Jun	1641	410	35-53.7	5-47.2	
289	606	179	28 Jun	1720	492	35-53.8	5-47.2	
290	606	179	28 Jun	1800	363	35-53.8	5-47.5	
291	606	179	28 Jun	1841	500	35-53.8	5-47.2	
292	606	179	28 Jun	1920	556	35-53.6	5-47.1	
293	606	179	28 Jun	1957	486	35-53.6	5-47.6	
294	606	179	28 Jun	2039	613	35-53.6	5-47.4	
295	606	179	28 Jun	2118	613	35-53.8	5-47.0	
296	606	179	28 Jun	2200	499	35-53.9	5-47.2	
297	606	179	28 Jun	2254	484	35-53.8	5-47.3	
298	606	179	28 Jun	2343	550	35-53.8	5-47.3	
299	606	180	29 Jun	0020	545	35-53.8	5-47.3	
300	606	180	29 Jun	0100	610	35-53.8	5-47.3	
301	606	180	29 Jun	0140	497	35-53.8	5-47.3	
302	606	180	29 Jun	0220	502	35-53.8	5-47.2	
303	606	180	29 Jun	0300	526	35-53.7	5-47.3	
304	606	180	29 Jun	0340	469	35-53.7	5-47.4	
305	606	180	29 Jun	0420	466	35-53.7	5-47.3	
306	606	180	29 Jun	0506	466	35-53.8	5-47.2	
307	606	180	29 Jun	0540	435	35-53.8	5-47.5	
308	606	180	29 Jun	0619	502	35-53.8	5-47.0	
309	606	180	29 Jun	0703	524	35-53.8	5-47.2	
310	606	180	29 Jun	0740	548	35-53.7	5-47.0	
311	606	180	29 Jun	0819	534	35-54.0	5-47.4	
312	606	180	29 Jun	0859	494	35-53.8	5-47.3	
313	606	180	29 Jun	0938	592	35-53.7	5-47.0	
314	606	180	29 Jun	1021	481	35-53.8	5-46.2	
315	606	180	29 Jun	1100	532	35-53.8	5-47.1	
316	606	180	29 Jun	1140	532	35-53.8	5-47.3	
317	606	180	29 Jun	1219	502	35-53.8	5-47.2	
318	606	180	29 Jun	1300	552	35-53.8	5-47.3	
319	606	180	29 Jun	1340	479	35-53.8	5-47.2	

Table 2. Salinity calibration

Station	Sample	Pressure	Salinity	Salinometer—CTD	Remarks
104042	1	114	35.983	+0.012	
	2	114	35.983	+0.012	
105043	1	74	36.251	+0.017	
	2	74	36.353	+0.019	
106044	1	262	37.384	+0.017*	
	2	262	37.399	+0.032	
107045	1	276	37.156	+0.051*	
	2	276	37.096	+0.009	
108046	1	375	38.188	+0.004*	
	2	375	38.170	−0.014	
109047	1	270	36.967	−0.043*	
	2	270	37.006	+0.004	
204054	1	248	38.134	−0.042*	
	2	248	38.194	+0.018	
205055	1	248	38.233	+0.012*	
	2	248	38.199	−0.002	
206056	1	419	38.356	+0.007	
	2	419	38.366	+0.017	
207057	1	402	38.332	+0.021	
	2	402	38.331	+0.020	
208058	1	229	36.601	+0.010	
	2	229	36.600	+0.009	
304072	1	273	38.400	+0.011	
	2	275	38.402	+0.013	
606073	1	508	38.405	+0.016	
	2	510	38.412	+0.023	
606077	1	263	38.177	+0.017*	Rapidly changing salinity
	2	276	38.147	−0.003	
606081	1	394	38.432	+0.011	
	2	401	38.432	+0.011	
606085	1	377	38.388	+0.013	
	2	379	38.395	+0.020	
606089	1	404	38.393	+0.018	
	2	404	38.389	+0.014	
606093	1	472	38.345	+0.031	
	2	476	38.340	+0.027	
606097	1	391	38.383	+0.025	
	2	394	38.386	+0.024	
606101	1	368	38.399	+0.002*	Pressures uncertain
	2	390	38.424	+0.021	
606105	1	478	38.417	+0.013	
	2	478	38.425	+0.021	
606109	1	417	38.367	+0.008	
	2	417	38.375	+0.016	
802114	1	503	38.437	+0.010	
	2	503	38.434	+0.007	
802118	1	537	38.433	+0.010	
	2	537	38.434	+0.011	
802122	1	551	38.438	+0.011	
	2	551	38.437	+0.010	

Notes: (1) Values with "*" show disagreement greater than 0.010 between bottles tripped close together.

(2) Summary statistics (N: number of samples, M: mean, and SD: standard deviation).

All samples:	M = +0.011, SD = 0.012 (N = 77)
Calibration station:	M = +0.011, SD = 0.003 (N = 9)
East of sill only:	M = +0.010, SD = 0.002 (N = 24)
West of sill (exclusive of stations with asterisk):	M = +0.016, SD = 0.006 (N = 28)
All samples (exclusive of stations with asterisk):	M = +0.013, SD = 0.006 (N = 61)

Table 2. Salinity calibration

Station	Sample	Pressure	Salinity	Salinometer—CTD	Remarks
802126	1	547	38.436	+0.010	
	2	547	38.428	+0.002	
802130	1	543	38.433	+0.012	
	2	543	38.427	+0.006	
802134	1	605	38.438	+0.013	
	2	605	38.438	+0.013	
802138	1	597	38.436	+0.011	
	2	597	38.435	+0.010	
802142	1	532	38.432	+0.012	
	2	532	38.431	+0.010	
800151	1	400	38.452	+0.004	Calibration station
	2	409	38.460	+0.012	
	3	500	38.445	+0.007	
	4	509	38.450	+0.012	
	5	607	38.441	+0.011	
	6	709	38.438	+0.013	
	7	710	38.436	+0.011	
	8	809	38.434	+0.013	
	9	818	38.433	+0.012	
603181	1	531	38.444	+0.013	
	2	541	38.447	+0.012	
404182	1	808	38.443	+0.010	
	2	826	38.441	+0.009	
602183	1	844	38.434	+0.010	
	2	847	38.433	+0.009	
601184	1	824	38.431	+0.008	
	2	826	38.430	+0.009	

Table 3. Edited data

Cast Number	Pressure Interval (dbar)	Comments	Cast Number	Pressure Interval (dbar)	Comments
108005	335.7–337.5		802241	30.1–30.9	
108006	421.8–422.2			72.8–73.4	
	422.9–423.4		802245	214.1–214.5	
108015	332.3–334.4		606248	325.7–326.9	
108016	9.0–9.5		606251	4.0–4.5	
	32.5–32.7			5.2–5.7	
108034	350.0–352.1			7.2–9.9	
103041	39.5–40.8			11.0–11.1	
201051	19.8–21.0			15.4–16.3	
204054	118.8–120.7		606255	7.2–8.0	
205055	52.5–53.4			11.2–12.8	
	66.1–66.3			84.0–84.0	
206056	7.5–9.2			99.2–102.4	
204063	2.3–3.1			180.8–182.4	
205064	132.5–135.3			217.7–220.0	
	261.4–263.1			274.8–276.8	
209068	72.2–72.3		606256	164.4–166.0	
	82.7–83.4		606262	363.9–364.8	
606085	53.2–54.9			481.3–481.9	
606091	17.2–18.2		606263	133.4–135.7	
606092	52.8–53.2		606268	452.7–454.8	
606102	445.2–446.1		606269	86.9– 88.3	
606108	20.0–20.3			343.8–344.5	
802118	11.8–12.9		606270	37.8–39.3	
	331.5–332.1		606274	481.2–481.2	
802129	88.9–89.3		606276	66.0–66.5	
802130	303.8–304.4			397.7–398.9	
802134	5.0–5.4		606277	63.1–64.1	
	107.4–108.0			537.0–541.0	
	549.4–549.8			546.9–547.4	
802135	4.7–5.7			589.9–591.2	
	458.4–460.2		606278	311.7–313.7	
	601.6–603.4		606280	449.5–461.2	
802138	231.4–232.2		606282	411.3–414.1	
	624.7–626.2		606285	542.7–542.9	
802140	209.5–210.3			548.3–548.7	
802141	330.3–332.2		606287	156.2–157.5	
902167	229.7–230.9			249.1–249.3	
902168	7.2–7.7		606288	396.6–396.7	
608174	11.6–12.6		606291	43.3–44.9	
	84.8–85.3		606293	166.8–167.7	
	449.9–450.2		606295	37.2–37.9	
802207	3.3–3.7			39.7–40.8	
802211	53.1–53.7		606297	64.1–66.2	
802213	All	Downcast replaced with upcast		160.7–162.9	
802218	51.5–52.4		606300	109.0–111.1	
802233	5.7–6.3			180.8–182.5	
802235	204.9–206.4		606304	84.8–85.9	
802240	297.7–299.2		606309	376.3–377.0	
	544.3–545.9		606310	97.9–99.5	
			606311	306.2–309.1	

Note: Data from all pressure intervals were replaced by linear interpolation.